

**Mole Conversions**

What is the mass of  $8.67 \times 10^{15}$  molecules of  $C_2H_6$ ?  $= 2(12.01) + 6(1.01) = 30.08 \text{ g/mol}$

$$8.67 \times 10^{15} \text{ molecules} \left( \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \right) \left( \frac{30.08 \text{ g}}{1 \text{ mol}} \right) = 4.33 \times 10^{-7} \text{ g}$$

**Density (STP conditions)**

What is the molar mass of a gas that has a density of  $0.065 \text{ g/ml}$  at STP?

$$D = \frac{m}{V} \quad DV = m \quad \frac{0.065 \text{ g}}{\text{mL}} \left( \frac{1000 \text{ mL}}{1 \text{ L}} \right) \left( \frac{22.4 \text{ L}}{1 \text{ mol}} \right) = 1500 \text{ g/mol}$$

**Density (non-STP conditions)**

The density of sulfuric acid is  $1.85 \text{ g/cm}^3$ . How many oxygen atoms are there in  $1.5 \text{ L}$  of sulfuric acid?  $H_2SO_4 = 2(1.01) + 1(32.07) + 4(16.00) = 98.09 \text{ g/mol}$

$$D = \frac{m}{V} \quad m = DV \quad \frac{1.85 \text{ g}}{\text{cm}^3} \left( \frac{1000 \text{ cm}^3}{1 \text{ L}} \right) \left( \frac{1.5 \text{ L}}{1} \right) \left( \frac{1 \text{ mol}}{98.09 \text{ g}} \right) \left( \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \right) \left( \frac{4 \text{ O atoms}}{1 \text{ molecule}} \right) = 6.81 \times 10^{25} \text{ atoms}$$

**Percent Composition**

What is the percent composition by mass of chromium in chromium III dichromate?

$$Cr_2(Cr_2O_7)_3 \quad \text{mass of Cr} = 8(52.07) = 416.00 \text{ g}$$

$$\text{mass of } Cr_2(Cr_2O_7)_3 = 8(52.07) + 21(16.00) = 752 \text{ g}$$

$$\frac{416}{752} \times 100 = 55.3 \%$$

Determine the empirical formula of a compound with the following composition by mass:

60.0 % C, 12.0 % H and 28.0 % N.

If this compound has a molar mass of  $300 \text{ g/mol}$ , what is its molecular formula?

$$\text{Empirical } C_5H_{12}N_2 = 100 \text{ g}$$

$$60.0 \text{ g C} \left( \frac{1 \text{ mol C}}{12.01 \text{ g}} \right) = \frac{4.9958}{1.9986} = 2.5 \times 2 = 5$$

$$12.0 \text{ g H} \left( \frac{1 \text{ mol H}}{1.01 \text{ g}} \right) = \frac{11.8812}{1.9986} = 5.94 \times 2 = 12$$

$$28.0 \text{ g N} \left( \frac{1 \text{ mol N}}{14.01 \text{ g}} \right) = \frac{1.9986}{1.9986} = 1 \times 2 = 2$$

$$\frac{300}{100} = 3$$

$$\text{molecular } C_{15}H_{36}N_6$$